Beginning the Second Century

Agricultural and Biosystems Engineering

Departmental Strategic Plan

(2004-2009)

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY

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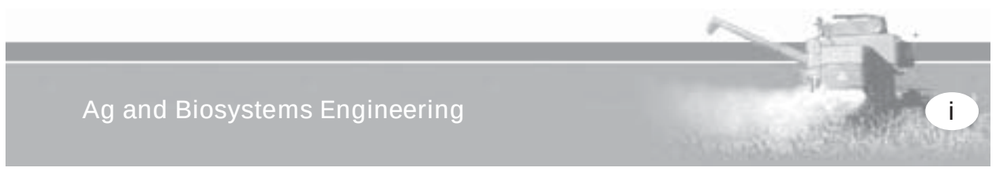


The Vision

ISU's Department of Agricultural and Biosystems Engineering: The premier team serving agriculture and society through engineering for living systems.

The Mission

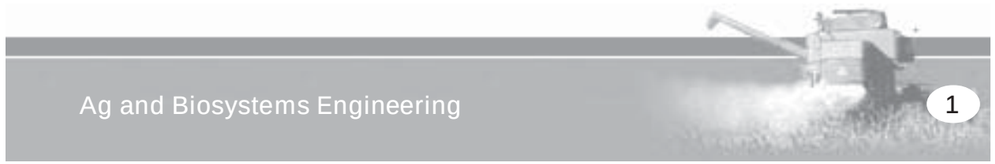
The mission of the Agricultural and Biosystems Engineering Department is:

- to promote undergraduate and graduate student learning in agricultural engineering and agricultural systems technology,
- to discover and improve new technologies for all stakeholders, and
- to provide engineering expertise in the fields of agriculture and biosystems for the state, nation, and world.

Values and Guiding Principles

As the Agricultural and Biosystems Engineering department works toward achieving our mission, all members of the department are requested to act in harmony with Iowa State University's core values and the identified departmental values and guiding principles. These departmental values and guiding principles are:

- Diversity of students, staff, faculty, stakeholders, and viewpoints
- Partnerships with stakeholders
- Resources and infrastructure
- Systems identity
- Lifelong learning



The Process of Strategic Planning

The strategic planning process for the department was conducted over a course of one and half years beginning at the Fall 2002 departmental retreat. Invited stakeholders and faculty participated in our strategic plan by drafting the vision and mission statements. Over the course of a year, several faculty group meetings were used to explore goals, strategies, and benchmarks addressing the adopted departmental vision and mission in the context of discovery, learning, and engagement.

The strategic writing committee (Tom Brumm, Mary Ellen Hurt, Ramesh Kanwar, Manjit Misra, Stewart Melvin, and Chuck Schwab) used the information gathered during the retreat and these other meetings to formulate a unified strategic plan. This strategic plan was shared with the faculty and staff and refined based on active participation and discussion. The original three focus areas were developed into four themes: Environmental Stewardship Engineering, Plant and Animal Production Engineering, Processing Engineering for Food Safety and Value Addition, Advanced Machinery Engineering with an additional fifth crosscutting theme of Implementing Values and Guiding Principles.

The five theme areas were presented at a faculty meeting and approved. These themes were developed into this current strategic plan that was passed during the January 2004 faculty retreat.

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Themes and Goals

The department has identified five themes of excellence that best describe our current and future learning, discovery, and engagement activities. They are:

- Environmental Stewardship Engineering
- Plant and Animal Production Engineering
- Processing Engineering for Food Safety and Value Addition
- Advanced Machinery Engineering
- Implementing Values and Guiding Principles

These themes share three common goals that encompass our talents, strengths, and expertise.

This combination of Themes and Goals gives us an efficient system for collaboration and communication within our department. The following section presents the ABE Themes of Excellence with goals, strategies, and success indicators.

THEME 1 – Environmental Stewardship Engineering

Quality soil, water, and air resources are socially and economically important to Iowa, the U.S., and the world. Environmental stewardship engineering is needed to develop and disseminate information and technology that allows those resources to be efficiently used to produce food, feed, and fiber, while maintaining or improving their quality.

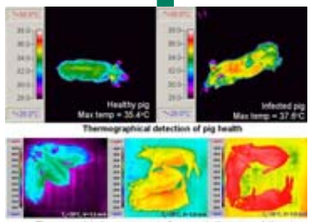
Goals	Strategies	Success indicators
Improve resource management systems	• Generate knowledge/information needed in developing new components for improved systems • Develop sensors to monitor emission of pollutants (particulates and odorous, greenhouse, and other gases) from agricultural production systems • Conceive and test equipment/techniques to reduce/control atmospheric pollutant emissions • Develop improved nutrient management practices (rate, method, and timing of manure and fertilizer applications) to reduce losses from cropland • Evaluate new soil and water management practices to reduce chemical losses • Quantify and where needed develop methods to reduce losses of biological pollutants (bacteria, viruses, parasites, and antibiotics used to control them) • Evaluate off-site practices for treatment/pollution control where on-site practices may not be adequate	• Publication record relative to new knowledge/information and improved practices/systems • Patent applications on innovative ideas, equipment, and methods for resource protection/pollution control • Hardware and software tools for monitoring and control of pollutant emissions from agricultural production systems • New options for determining rate, and methods and timing of nutrient applications • Assessment of importance of biological contaminants and possible control • Establishment of design parameters for use of off-site practices for pollution control
Optimize environmental systems	• Adapt, evaluate, and utilize mathematical models/information systems to optimize design of pollution prevention systems • Optimize cropping, tillage, chemical, soil, and water management practices to reduce negative environmental impacts while sustaining productivity • Assess benefits of off-site landscape modification/engineering for environmental enhancement • Provide input into TMDL planning and watershed protection	• Validated models available for assessment of cost/benefits of improved systems • Release of recommendations on appropriate combinations of cropping, tillage, chemical, soil, and water management practices for pollution control • Release of recommendations for use of off-site practices for pollution control
Integrate and implement technology for environmental systems	• Establish an “Environmental Engineering Center for Agriculture” at ISU • Sponsor national/international conferences on agricultural environmental issues • Develop electronic delivery systems for dissemination of technical information on pollution control for agriculture • Take active role in communicating with action agency personnel implementing pollution control programs • Continue to educate traditional and non-traditional audiences of the needs and opportunities relative to improved resource management systems	• Official recognition of new “Center” • National/international conference held in Iowa • Electronic education modules developed and web-based delivery system upgraded • Faculty serving as members on governmental and industrial advisory panels/boards • Documented evidence of educational impacts on producer performance

THEME 2 – Animal and Plant Production Engineering

The demand for efficient, safe and sustainable production of food animals and crops continues to increase. Leading the nation in both counts, Iowa has a vital interest and position to advance the related science, engineering and technology. APPE strives to discover relationships between living systems and their development variables, investigate engineering solutions to alleviate adverse impacts of environment on living systems and disseminate the latest information to our stakeholders.

Goals	Strategies	Success indicators
Quantify, develop, and evaluate animal and plant production systems	• Quantify animal and plant responses to modified environmental conditions that will advance the understanding of the synergistic impacts of environmental factors on modern animals and plants • Investigate engineering strategies for animal and plant stress relief to enhance health and well-being • Develop intelligent sensors and/or control systems for precision animal and plant production systems to reduce cost of production and environmental impact • Quantify aerial emissions from animal feeding operations and evaluation of means to mitigate the emissions to enhance the sustainability of animal production agriculture • Develop methods to evaluate economic and environmental consequences of variable rate management for precision agriculture • Encourage involvement and leadership roles in multi-state, multi-nation scholarly activities	• Institutional and professional awards in recognition of faculty accomplishments • Faculty serving in leadership or advisory roles with professional societies, government agencies, and commodity groups • International invitations for academic exchanges (e.g., sabbatical), serving on graduate program committees, presentation at special workshops or symposia • Publication record of refereed journal articles • Recognized experts by college/university administrations, state and federal agencies, and commodity groups to address issues that face the animal and crop industries • Increased joint authorships with internationally prominent overseas scholars
Optimize animal and plant production systems	• Systematically integrate research-based information and methods both independently and collaboratively with cross-disciplinary colleagues, to optimize animal and plant production systems • Work toward integrated management systems (IMS) that will prove sound with respect to animal welfare, product safety and quality, impact on the environment, and cash return • Enhance partnerships with interdisciplinary and intra- and inter-institutional colleagues to maximize the efficiency of resources utilization, the likelihood of success, and the magnitude of impacts • Optimize plant and animal production models (e.g., plant growth, downwind dispersion of aerial emissions from animal feeding operations)	• New measurement or sampling systems or methods developed for monitoring emissions and downwind concentrations of aerial pollutants associated with animal feeding operations • Innovative control systems or algorithms developed for optimal operation of equipment used to control micro-environment in animal and plant production systems • Patents or intellectual disclosures granted or filed that result from our research and development efforts • New systems or control strategies derived from our scholarly activities are implemented

Integrate and implement technology for animal and plant production systems	• Share faculty knowledge of air quality expertise through reciprocal faculty visits and hosting of training workshops on air quality
	• Work closely with ABE field specialists to effectively deliver departmental animal and plant programs
	• Offer a web-based delivery of production-oriented decision support tools
	• Augment local, national and international impacts of our programs by having faculty
	  o serve in leadership capacities inside professional societies
	  o serve on advisory boards/review panels with governmental or industry organizations
	  o present invited lectures at national and international events
	  o consult for prominent national or international clients or institutions
	• Enhance undergraduate and graduate programs through
	  o early involvement of undergraduates in research activities
	  o new dual-listed (graduate and undergraduate) course on air quality and measurement techniques as related to animal feeding operations
	  o efforts to recruit domestic students into graduate programs (particularly Ph.D.)
		• Air quality conferences and workshops that are hosted
		• Newspapers around the state will carry articles on ABE success stories
		• Grants written by department faculty will have an outreach component
		• Partnership with industries in development of new products or improvement of existing products
		• Undergraduate and graduate student enrollment have increased domestic and minority students
		• Number of M.S. and Ph.D. awarded



Thermographical detection of pig health

Thermographical measurement of young pig thermoregulation

THEME 3 – Process Engineering for Food Safety and Value Addition

Adding value to agricultural products creates economic and social benefits for the people of Iowa, provides renewable resources, and helps ensure efficient utilization of inputs. Food safety and security continue to be a consumer concern. We will assist, through research in and application of engineering principles, in providing Iowans with a safe and efficient food system that captures value.

Goals	Strategies	Success indicators
Design and develop advanced systems for food safety and value addition	• Generate knowledge and information needed to develop new ways to capture value in agricultural and biorenewable products • Develop sensors and other measurement technology for effectively measuring properties related to value addition and food safety, e.g., pathogens, composition, etc.	• Productive publication record relative to new knowledge/ information • Establishment of new processes and/or products based on research results • Significant collaboration with the Center for Crops Utilization Research
Optimize food safety and value addition systems	• Model process operations for understanding of value and efficiencies • Quantify food safety risks in agricultural and processing operations • Optimize grain drying and storage systems through such technologies as rapid deterioration detection and ultra high temperature drying • Generate knowledge and information needed to improve current systems that capture value in agricultural and biorenewable products	• New systems or strategies derived from our scholarly activities are implemented
Integrate and implement technology for food safety and value addition	• Implement a degree in Biological Systems Engineering to provide engineers to industry with the skills and talents to address value addition and food safety issues • Implement Quality Management Systems for agricultural and processing industries to enable source verification and appropriate segregations • Incorporate QMS into our learning and outreach programs • Engage Iowa's value-added industries, using their input to guide discovery, learning, and outreach efforts, and providing them with engineering expertise to address their problems and opportunities • Maintain and further develop the Seed Conditioning outreach program	• ABET accreditation of biological systems engineering progra • Industry marketing of value-added machines and processes

THEME 4 – Advanced Machinery Engineering

The agricultural industry producing the food, feed, and fiber for Iowa, the U.S. and the world is dependent on machinery systems. Advanced machinery engineering has a critical role in developing, refining, and implementing emerging technologies to improve machinery systems for the future.

Goals	Strategies	Success indicators
Design and develop advanced machines and systems for agriculture	• Solve fundamental engineering and technology questions related to agricultural machinery • Expand research program on advanced and emerging technologies related to agricultural machinery and outdoor power equipment in o intelligent and autonomous machines o biorenewables production o mechatronics o sensors • Expand research partnerships with key industries • Pursue a funded endowed engineering chair in advanced machinery	• Industry partnerships and sponsored projects • Technologies transferred and adopted • Faculty accepted invited local national and international presentations • Innovative designs, modeling, systems, or algorithms developed for optimal operation of agricultural equipment and equipment systems • Endowed chair funded
Optimize machinery and systems	• Explore cost effective size-neutral technology for agricultural machinery • Develop research programs investigating o Integration of information technology (IT) in agricultural machinery and systems o Impact of agricultural machinery on sustainability o Evaluate sensors and artificial intelligence for agriculture • Explore research and education opportunities with outdoor power equipment industry	• Faculty accepted invited local national and international presentations • New systems or control strategies derived from our scholarly activities are implemented • Partnerships with outdoor power equipment industry • Level and continuity of support number of publications
Integrate and implement technology for advanced machinery engineering	• Striving to achieve the 1st choice status for students searching for agricultural machinery undergraduate and graduate education • Improve curriculum with state of the art technology, biorenewables, and business components • Add a new faculty position to reach a critical mass in the Advanced Machinery Engineering group • Assist clients in decision-making, economic analysis, and operation of machinery systems	• Undergraduate and graduate students enrolled in the curriculum for agricultural machinery • Qualifications of applicants enrolling in the machinery undergraduate and graduate programs • Level and continuity of external research support

THEME 5 – Implementing Values and Guiding Principles *Values and guiding principles are at the heart of any successful learning, discovery, and engagement programming. The department's values and guiding principles are in harmony with Iowa State University's core values and those identified by the colleges of agriculture and engineering.*		
Goals	**Strategies**	**Success indicators**
Boost diversity in people and thought	• Recruit non-traditional ABE students in at least 2 large Iowa high schools and through SWE • Target and develop several undergraduate scholarships for increasing our diversity • Develop/market curricula with broader appeal • Establish 2+2 programs with community colleges • Encourage international experiences for students and faculty • Encourage diversity in the department with visiting international scholars and relationships with 1890's and 1994's schools	• Percentages of women and minorities in the undergraduate program • Number of 2+2 programs with community colleges • Students and faculty with international experiences • Inclusion of a dean from an external institution and a representative of a 1890/1996 institution on the ABE Industrial Advisory Council • Partnerships and relationships that include diversity
Improve engagement with stakeholders	• Develop an Agricultural Systems Technology industrial advisory committee • Host an annual ABE industry appreciation day • Implement an outstanding alumni recognition program • Provide monthly/semester email updates to our stakeholders	• Accomplishments of the AST industrial advisory committee • Participation in the annual ABE industry appreciation day • Quality and numbers of recognized ABE alumni • Monthly/semester communications with stakeholders
Advance learner-centered pedagogy and implement outcomes assessment	• Develop and implement outcomes assessment plan through existing curriculum committees • Provide departmental assessment/learning workshops • Allocate faculty release time and staff time for learning/assessment • Obtain further support to development of ABE Learning communities • Secure external funding for learning/assessment efforts (NSF, USDA, foundations, etc.) • Further emphasize SoTL through release time, resources, etc	• Implementation outcomes assessment plan • Workshops offered on assessment/learning • Faculty release time • Grants dollars generated for ABE learning communities • SoTL papers published each year
Reinforce resources and departmental infrastructure	• New building – Just Do It! • Increased support staff in identified critical needs areas o an electronics technician for research and teaching technology o a professional student specialist for outcome assessments	• Groundbreaking for new departmental building • Positions funded and filled

Departmental Performance Objectives

This strategic plan outlines how the Agricultural and Biosystems Engineering department will achieve success on the five themes identified. The department will annually evaluate its plans and programs to ensure steady progress towards the vision and mission of this strategic plan. In addition to the success indicators outlined in each theme, the department will measure success with the set of key performance indicators given below.

Key Performance Indicators

- Replacement of two faculty positions in the area of animal and plant production engineering by fall 2004
- Replacement of faculty position in the area of advanced machinery engineering by fall 2004
- Replacement of two faculty positions in the area of environmental stewardship engineering by fall 2004
- Replacement of faculty position in the area of process engineering for food safety and value added by fall 2006
- Add two endowed professorships in by 2008
- 3.0 SCHs/K academic budget Agricultural College
- 400 SCHs/teaching FTEs Agricultural College
- 28 undergraduate Majors/K academic budget Agricultural College
- 100% student placement at graduation Agricultural College
- 90% of undergraduate students have internship or study-abroad experience Agricultural College
- 1.0 SCHs/K academic budget Engineering College
- 150 SCHs/teaching FTEs Engineering College
- 28 undergraduate Majors/K academic budget Engineering College
- 95% student placement at graduation Engineering College
- 50% of undergraduate students have internship or study-abroad experience Engineering College
- 1.1 M.S. graduates/Teaching FTEs
- 1.1 Ph.D. graduates/Teaching FTEs
- Establish B.S. degree curriculum in Biological Systems Engineering
- 2.0 Peer-Reviewed Publication/Faculty FTEs/year
- 95% Tenured/Tenured Track Faculty as PI or Co-PI for external funding
- 5.0 million in departmental expenditures from External Funding
- 0.2 million in awards from External Funding/Faculty FTEs
- 0.7 Intellectual Property Disclosures, Patents, license/year
- 5 interdisciplinary or cross departmental cooperative programming efforts
- 5 of Extension Programs Achieving Positive Change
- 5 Strategic industrial partnerships/department
- 8 of faculty providing leadership at national professional societies
- 10 million Dollars raised from private gifts
- New Agricultural and Biosystems Engineering building built by 2009

Historical Relevance of Department

Leadership in developing a discipline to apply engineering and agricultural sciences and technologies to biological systems has its roots in Iowa. At the turn of the 20th century this emerging discipline was focused on providing engineering solutions for mechanizing agriculture. This endeavor led to establishment of the agricultural engineering profession. In 1905, the name of the farm mechanics program within the Department of Agronomy at Iowa State College was changed to “Agricultural Engineering,” and given department status. Dr. J. Brownlee Davidson joined the staff as assistant professor and head of this new department.

The 1906-07 college catalog announced “the degree of Bachelor of Agricultural Engineering,” coordinated through the College of Engineering. This was the first agricultural engineering degree offered in the United States and Mr. Jacob E. Waggoner earned the first degree in 1910.

The Master of Science degree in Agricultural Engineering at Iowa State College was first offered in 1918. The Doctor of Philosophy degree was established in 1938 as a co-major between Agricultural Engineering and other departments. Dr. Henry J. Barre was the first recipient of a Ph.D. in Ag Engineering-Physics at Iowa State in 1938 and is believed to be the first Ph.D. recipient in Agricultural-Engineering in the United States. In 1962, the Ph.D. in Agricultural Engineering was offered as a single major. The Agricultural Engineering undergraduate curriculum at Iowa State became one of the first three accredited Agricultural Engineering programs in the United States in 1936 and has maintained accreditation by the Accreditation Board for Engineering and Technology (ABET) since that time. During 1974, the Agricultural Mechanization degree was developed and offered through the College of Agriculture.

Through 2003, 1,423 agricultural engineering students have received their Bachelor of Science degrees in Engineering at Iowa State University and 479 students have graduated from the Agricultural Mechanization program. The M.S. degree has been awarded to 448 students and 218 students have been granted the Ph.D. from the Department. These 2,568 graduates form one of the largest alumni groups of any Agricultural Engineering Department in the United States.

The Iowa State Agricultural Engineering Department is currently ranked in the top ten engineering departments in the nation. Departmental statistics for two years:

Category	1990	2003
Total Faculty	23	24
Undergraduate enrollment	98	264
Graduate student enrollment	41	39
Total FTE:		
Teaching	7	9
Research	9	9
Extension	7	4
Ranking:		
US World News Report:		
Undergraduate Programs	NA	5
Graduate Programs	NA	9

Summary

The Agricultural and Biosystems Engineering department is approaching the 100th year anniversary. During that time the department has lead the way in many endeavors that supported the profession, served the stakeholders, and contributed to the university. It is through this strategic plan that the department begins its second century of service with expectations of continued leadership. This department remains committed to the Land Grant philosophy of serving the people of Iowa, our nation, and the world through learning, discovery, and engagement, especially as human needs become more global in nature and population growth requires increased food supplies and security.

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Notes

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